ANAESTHESIA CONSIDERATION IN LAPAROSCOPY SURGERY

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LAPAROSCOPY:

- It is a “minimally invasive” procedure allowing endoscopic access to the peritoneal cavity after insufflation of a gas to create space between the anterior abdominal wall and the viscera.
- The space is necessary for safe manipulation of instruments and organs.

Benefits of the Laparoscopic Approach

- Minimised **incision size** and trauma — reduced postoperative discomfort
- Shortened **recovery rates** and earlier return to oral intake (reduced bowel manipulation → reduced ileus)
- Lower incidence of **wound infections** and systemic infections
- Reduced perioperative morbidity → shorter in-patient stay

Pneumoperitoneum: Pathophysiology

- Intra-abdominal laparoscopic surgery requires the intentional generation of a pneumoperitoneum using carbon dioxide insufflation to enable sufficient visualisation for the procedure to be performed.

Intra-Abdominal Pressure (IAP)

- IAP is the steady pressure within the closed abdominal cavity.
- Normal values of IAP are **5-7 mmHg.**
- Values more than 15 mmHg compromises venous return.
- Initial flow: 4–6 L/min.
- Maintenance:1-3L/min.

What Gases Can Be Used?

- Air, oxygen, carbon dioxide, argon and helium.
- **Ideal gas for insufflation** should be
  - **Nontoxic**
  - **Colourless**
  - **readily soluble in blood**
  - **easily ventilated through lungs**
  - **nonflammable and inexpensive.**
- Most widely used gas for insufflation: CO2

Category	Risks
Surgical (Trocar)	Visceral/vascular damage; bladder/bowel injury; retroperitoneal haematoma
Venous Gas Embolism	**Direct trocar-vessel puncture or insufflation of hollow organ; catastrophic circulatory collapse**
Positional — Trendelenburg	Cerebral oedema; V/Q mismatch worsened; upper airway oedema , endobronchial ETT migration
Well-Leg Compartment Syndrome	**Steep Trendelenburg >4h; lithotomy position , muscular lower limbs, obesity, Peripheral vascular disease**
Reverse Trendelenburg	Decreased venous return →hypotension; myocardial and cerebral ischaemia; more dangerous in elderly or IHD patients

Contraindications of laparoscopy

- **Absolute Contraindications**
  - Hemodynamic instability or uncontrolled shock
  - Known right-to-left cardiac shunts or patent foramen ovale (paradoxical gas embolism risk)
- **Relative Contraindications**
  - Severe ischaemic heart disease
  - Valvular disease
  - Significant renal dysfunction — compounded AKI risk
  - End-stage respiratory disease — hypercarbia management may be challenging
  - Raised intracranial pressure

❖ Effects of Creating a Pneumoperitoneum

- As the volume of the abdomen increases, **abdominal wall compliance decreases and intra-abdominal pressure (IAP) increases**

- When the IAP exceeds physiological thresholds, blood flow in individual organ systems become compromised→
  - ❖ Respiratory effects
  - ❖ Cardiovascular effects
  - ❖ Neurological effects
  - ❖ Splanchnic effect

Respiratory Effects

- Diaphragm pushed cephalad → limited movement →**reduced FRC**, reduced pulmonary compliance
- Increased intrathoracic pressure → **pulmonary atelectasis, V/Q mismatch**, hypoxaemia
- CO2 absorbed from peritoneum → **increased PaCO2 and ETCO2**
- Steep Trendelenburg significantly worsens all respiratory parameters
- ETT may migrate **endobronchial** in steep Trendelenburg

Respiratory Complications:

- CO2 Subcutaneous Emphysema
- Pneumothorax
- Pneumomediastinum
- Gas Embolism
- Aspiration of Gastric Contents

Cardiovascular Effects

- **Increased SVR (**Systemic vascular resistance) : mechanical compression of abdominal aorta and activation of neurohumoral factors (vasopressin, RAAS axis)
- **Decreased preload**: IVC compression reduces venous return -> decreased cardiac output
- Cephalad diaphragm displacement raises intrathoracic pressure, further **impaired cardiac filling**
- **Bradycardia**: vagal stimulation during peritoneal insufflation

Splanchnic Effects

- Blood flow to kidney and liver compromised with increasing IAP
- IAP >20 mmHg: mesenteric and GI mucosal blood flow reduced by up to 40% — progressive tissue acidosis

- Renal: IAP of 20 mmHg reduces GFR by approximately 25%
    - **Mechanism: decreased renal afferent flow (decreased CO) + increased renal venous pressure (elevated IAP) + increased renin-angiotensin -> impaired perfusion gradient**

- Raised IAP is recognised as an independent cause of acute kidney injury

Neurological Effects

- Elevated IAP causes **increased intracranial pressure (ICP)** by limiting cerebral venous drainage
- Mechanism: raised intrathoracic pressure → **impaired jugular drainage** → elevated ICP
- Risk of temporary neurological dysfunction on emergence from prolonged laparoscopic procedures
- Especially concerning in cases requiring extended periods of steep Trendelenburg positioning

Cardiovascular Effects of Pneumoperitoneum on CVS

- Increased systemic vascular resistance (SVR)
- Decreased venous return
- Reduced cardiac output
- Increased mean arterial pressure (MAP)
- Elevated central venous pressure (CVP)

Anaesthesia Consideration:

- The most common technique used for laparoscopic surgery → General Anaesthesia.
- **It protects against gastric acid aspiration, allows optimal control of CO2, and facilitates good surgical access**.
- Bag and mask ventilation before intubation should be **minimized** to avoid gastric distension.
- Insertion of a **nasogastric tube** required to deflate the stomach — improves surgical view and avoids gastric injury on trocar insertion.
- Always **recheck ETT position** after positioning — endobronchial migration occurs with cephalad diaphragm shift

- Target **normocapnia** — increase respiratory rate or tidal volume to compensate for CO2 absorption
- **Periodic ABG** in prolonged/high-risk cases
- Peak and plateau airway pressures: essential for detecting reduced compliance
- **Invasive arterial blood pressure**; essential in cardiovascular disease or haemodynamic instability
- Addition of titrated levels of **PEEP** can be used to minimize alveolar derecruitment.
- **Adequate preloading** before insufflation to mitigate IAP-induced decrease in preload

Monitoring

- Continuous ECG
- NIBP monitoring
- Pulse oximetry (SpO2)
- Capnography (EtCO2)
- Temperature monitoring
- Urine output if patient is catheterised

Multimodal Analgesic Strategy

- Wound infiltration with local anaesthetic:
- Fascial plane block-
    - Transversus abdominis plane (TAP) block
    - Quadratus lumborum block
- NSAIDs
- Paracetamol
- Opioids

Shoulder Tip Pain :

- **Cause:** Referred pain due to irritation of the diaphragm, most commonly from CO_2 pneumoperitoneum.
- CO_2 insufflation stretches and irritates the diaphragm.
- The diaphragm is supplied by the **phrenic nerve (C3–C5).**
- Sensory fibers from the phrenic nerve referred pain to the shoulder tip

❖ **Preventive Measures**

- ➔ Slow insufflation rate
- ➔ Thorough evacuation of CO_2 at the end of surgery
- ➔ Low-pressure pneumoperitoneum

THANK YOU